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Natural History Notes on the Amphibians of a Recently Extirpated Suburban Wetland in Central Virginia

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The decline of amphibian populations has been documented throughout various parts of the world (Phillips, 1990, 1994; Wake, 1991; Livermore, 1992; Blaustein, 1994; Pechmann & Wilbur, 1994) and has been linked to several causes. Habitat loss is often listed as the most serious cause (e.g., Bragg, 1960; Hoffman, 1992; Blaustein & Wake, 1995). Others include a virus (Anderson, 1995), a fungus (Blaustein et al., 1994b), increased ultraviolet radiation (Blaustein, 1994a; Kiesecker & Blaustein, 1995), acid precipitation (Bradford et al., 1992), and introduced species (Hayes & Jennings, 1986; Bradford, 1989; Richards et al., 1993). Amphibian populations of eastern North America apparently have not been declining at the same rates as those elsewhere. Available information from long-term studies in protected habitats (Pechmann et al., 1991; Hairston & Wiley, 1993) reveal no apparent negative or positive trends. Aside from the possibility of acid precipitation (Freda & Dunson, 1985; Wyman, 1988), habitat loss remains the single most important cause of population decline and local population extirpation in the East.

Few baseline inventories of amphibian communities in Virginia have been published. Mitchell (1986) evaluated the phenology of an anuran community in a freshwater wetland bordering the Chesterfield County Airport in 1979 and 1980. Bogert (1952) and Organ (1961) studied the relative abundance of salamanders in southwestern Virginia. Species composition of amphibian communities for specific sites are included in, for example, the species lists in Dunn (1915), Richmond & Goin (1938), Hutchison (1956), Rageot (1964), Hill & Pierson (1986), Eckerlin (1991), Pague & Mitchell (1991), and Sattler (1995). Such species lists allow later evaluations of the impact of changes in land use and environmental perturbations. My objective in this paper is to record species occurrences and natural history observations on the amphibians inhabiting a wetland site in central Virginia that has been destroyed recently by suburban development.

MATERIALS AND METHODS

The study site was a small (about 15x25 m) woodland vernal pool ≤0.5 m deep located 3.7 km NNW Midlothian (at U.S. Rt. 60) immediately west of Co. Rt. 714 (Winterfield Road) in the Salisbury development district of Chesterfield County. The area was characterized by broad, shallow depressions which required ditching to lower the water table. Sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), willow oak (*Quercus phellos*), and white oak - post oak hybrids (*Quercus alba x stellata*) characterized the forest cover. The ground around the pool and pool substrate were covered with a layer of decomposing leaves. A grassy area (approximately 15 m in wide) in a telephone line right-of-way separated the margin of the woods from the paved road (Rt. 714). The vernal pool was located just beyond the tree line and drained by a shallow ditch that led into the grassy area. Several homes had been built in the area recently and ditches had been dug along the margins of all area roads. Water remained in the pool until mid-June in

1980. It did not refill until the following fall and winter due to a prolonged drought (Mitchell, 1986). Ambient and water temperatures were similar on the days the pool was sampled and ranged from 6° C to 11° C January through March, 14-18° C April-May, and 21-23° C in early June.

I made nocturnal visits to this site nine times between 14 January and 23 June 1980. The site was visited again on 24 November 1984, 12 October 1995, and 20 March 1996. All species that were observed visually or heard vocalizing were recorded and various aspects of their natural history were noted. Larval samples were obtained

Table 1. Chronological, stage-based development of *Pseudacris crucifer* tadpoles in the Salisbury wetland, Chesterfield County, Virginia, in 1980. N is sample size, Stage is the Gosner stage (Gosner, 1960), and % Sample is the percent of total sample for each date.

Date	N	Stage	% Sample
3 May	49	25	56.3
	27	26	31.0
	5	27	5.7
	1	29	1.1
	2	30	2.3
	3	34	3.6
17 May	139	25	50.2
	65	26	23.5
	21	27	7.6
	5	28	1.8
	7	29	2.5
	7	30	2.5
	4	31	1.4
	4	32	1.4
	6	33	2.2
	5	34	1.8
	10	35	3.6
	2	36	0.7
	1	40	0.4
	1	41	0.4
6 June	2	25	2.2
	3	27	3.3
	3	30	3.3
	4	32	4.4
	11	33	12.1
	3	35	25.3
	19	36	20.9
	21	37	23.1
	3	40	3.3
	2	41	2.2

Table 2. Chronological, stage-based development of *Rana clamitans* tadpoles in the Salisbury wetland, Chesterfield County, Virginia, in 1980. Refer to Table 1 for abbreviations.

Date	N	Stage	% Sample
14 January	345	25	88.5
	45	26	11.5
23 February	276	25	94.8
	15	26	5.2
25 March	16	25	43.2
	20	26	54.1
	1	27	2.7
7 April	13	26	56.5
	10	27	43.5
22 April	3	28	50.0
	2	29	33.3
	1	31	16.7
3 May	2	25	22.3
	4	34	44.4
	3	37	33.3
17 May	2	36	33.3
	2	38	33.3
	1	40	16.7
	1	41	16.7

with a dipnet and preserved in the field in 10% formaldehyde for later analysis. These samples were sorted in the laboratory to species. Anuran tadpoles were staged with the developmental staging sequence proposed by Gosner (1960). Snout-vent lengths of all salamander larvae were measured to the nearest millimeter.

RESULTS

A total of nine species of amphibians (6 anurans, 3 salamanders) was documented at the Salisbury site during this study. The following reptiles were also recorded: northern copperhead (*Agkistrodon contortrix mokasen*) collected in the dry pool bed on 23 June, and two eastern box turtles (*Terrapene carolina carolina*), one collected alive on 17 May and a shell found on 6 June 1980. Except as noted below, all dates refer to 1980.

Anurans

Hyla chrysoscelis - Two to three males were heard calling from trees on 6 June.

Pseudacris brimleyi - Males called at this site on 23 February, 25 March, and 7 April. They were found in syntopy with *P. triseriata* in an adjacent wetland dominated by sphagnum moss and *Smilax* sp. on 23 February. A chorus of 25-35 males called from wet woods lacking grass cover

on 25 March. A sample of four tadpoles of this species, all in Gosner stage 26, was collected on 22 April.

Pseudacris crucifer - Males were heard calling from 23 February through 3 May. Larval growth was well underway when the first tadpoles were collected on 3 May (Table 1). Metamorphs were found on 17 May and 6 June. The wide range of developmental stages represented on these dates reflects the prolonged breeding period and numerous cohorts typical of this anuran.

Pseudacris triseriata - Males were heard calling on 23 February and 25 March. This species occurred in microsyntopy (<1 m apart) with *P. brimleyi* in a sphagnum area approximately 0.5 km SE of the primary study site off Rt. 714. Both species were calling from the water's surface and while sitting on sphagnum. No tadpoles of this species were collected. One male was heard calling nearby on 20 March 1996.

Rana catesbeiana - One juvenile and one adult were observed in the vernal pool on 22 April and six juveniles were observed there on 6 June.

Rana clamitans - One to three adults were observed in the woodland vernal pool on 7 April, 3 May, and 17 May. Large samples of tadpoles were collected on 14 January and 23 February (Table 2). Despite the fact that very large numbers remained alive in the pool after these collections, dramatically smaller numbers were observed on and subsequent to 25 March. Larval growth occurred primarily between late February and mid-May; two individuals close to metamorphosis (stages 40 and 41) were collected on 17 May (Table 2). The few developmental stages represented in the samples compared to those in the *P. crucifer* samples (Table 1) indicate a relatively short breeding period and few cohorts.

Salamanders

Ambystoma maculatum - Three adults (2 females, 1 male) were collected on 23 February in the flooded grassy area. No courtship or mating behavior was observed. Egg masses containing embryos apparently at hatching stage were observed on 25 March. Two larvae collected on 17 May measured 17 and 18 mm SVL. Five larvae collected on 6 June averaged 25.4±1.1 mm SVL (OR= 24-27 mm).

Ambystoma opacum - Larvae of this species from the fall 1979 breeding period were present when the first collection was made on 14 January. Larval growth occurred between this date and 22 April, when three metamorphs were collected (Table 3). The average growth rate for the 97 day period from 14 January to 22 April was 0.29 mm/day. However, the growth rate was slower in the 14 January - 25 March period (0.13 mm/day) than in the warmer period of 25 March - 22 April (0.68 mm/day).

On 24 November 1984, I found one adult female (65 mm SVL) with a partial clutch of eggs in the dried, vernal pool area. On the same date approximately 100 m north of the pool in the same patch of woods, I found eight more females (mean SVL = 66.2±2.9 mm, range = 61.9-71.1) with 62-209 (mean = 112.9±45.1) eggs under moist logs. On 12 October 1995, I found an adult female with 188 eggs in a nest located in the former vernal pool under a 4-5 cm diameter branch in deep soil. No other salamanders were found under objects in the area.

Table 3. Chronological growth in snout-vent length of *Ambystoma opacum* larvae in the Salisbury wetland, Chesterfield County, Virginia, in 1980. All measurements are in millimeters.

Date	N	Mean+SD	Range
14 January	2	14.0	13-15
23 February	31	16.6±1.3	13-19
25 March	20	22.9±2.0	18-26
7 April	10	28.1±2.1	25-32
22 April	3	42.0±3.0	39-44

Table 4. Comparison of male calling periods and timing of metamorphosis for selected anurans at two sites in Chesterfield County, Virginia in 1980. The Chesterfield County Airport data are from Mitchell (1986) and those from the Salisbury site are from this study. Numbers are month/day and a dashed line indicates unavailable information.

	Calling period		Metamorphosis	
Species	Airport	Salisbury	Airport	Salisbury
P. brimleyi	2/22-4/22	2/23-4/7	4/17	—
P .crucifer	2/22-4/22	2/23-5/3	4/17	5/17-6/6
P. triseriata	2/22-4/22	2/23-3/25	—	—
R. clamitans	4/22-6/6	—	7/14	5/17

Notophthalmus viridescens - Adults were collected on 23 February, 25 March, and 7 April. The female collected on 25 March was gravid. No larvae of this species were observed.

DISCUSSION

Available comparative data for the frogs in this study are from Mitchell (1986), who studied an anuran community for two years (1979-1980) in a wet field at the Chesterfield County Airport, 21 km SE of the Salisbury study site. The late spring and summer period of 1980 was relatively dry compared to the same period in 1979. This resulted in substantial differences in breeding phenology and larval survivorship between the two years in spring and summer-breeding frogs (Mitchell, 1986). The early-breeding anurans experienced similar hydroperiods between years. The breeding phenology of these species at the Salisbury site mirrored that at the Chesterfield Airport (Table 4). Metamorphic *P. crucifer* were found 4-6 weeks later in the Salisbury site compared to the airport site. Neither of the two summer-breeding anurans, *Rana catesbeiana* and *R. clamitans*, were heard calling at the Salisbury site in 1980, whereas both called from late April to June at the Chesterfield County Airport site that year. Metamorphic larvae of *R. clamitans* were collected on 17 May at the Salisbury site but only on 14 July at the airport site. Such differences in timing between an open flooded field and a woodland vernal pool under canopy cover suggest that local physical environments influence variation in phenological events in anurans occupying the same geographic area.

There are no published studies on the timing of larval development and metamorphosis in ambystomatid salamanders in central Virginia. *Ambystoma maculatum* adults breed from February through March in the Piedmont and Coastal Plain of the state, depending on patterns of rainfall and temperature (personal observations). The dates of larval occurrence for both species of *Ambystoma* and the timing of metamorphosis in *A. opacum* reported here are consistent with observations from western Powhatan and central Goochland counties (J. C. Mitchell and C. Hatcher, unpublished).

In October 1995, the vernal pool and forested area were undergoing rapid changes. The telephone line right-of-way between the road and the section of woods containing the vernal pool had been compacted and was covered in short, partly mowed grass. The ditch between the road and the pool in this area had been almost entirely filled and planted with introduced lawn grasses. The area around the western margin of the vernal pool in the forest had been bulldozed for suburban roads and houses. At the end of the bulldozed area adjacent to the western side of the pool a large, square, concrete storm drain had been constructed. Property boundary stakes were located throughout the area and two of these were within the vernal pool area. Thus, the vernal pool I studied in 1980 apparently remained a viable breeding habitat for amphibians until 1995. Only a shallow vestige of the vernal pool remained on 20 March 1996 (Figure 1) despite heavy rains and snowfall in February and March; no amphibians were present. The recent construction of roads, storm drain systems, and homes in the area will prevent this site from retaining water from winter and

spring rains in the future, thus eliminating this woodland vernal pool and associated terrestrial habitats for amphibians.

Loss of aquatic, terrestrial, and arboreal habitats from construction of urban and suburban areas is the primary cause of population decline for amphibians and reptiles in growing metropolitan areas such as the counties of Chesterfield, Hanover, and Henrico around Richmond, Virginia. Construction of suburban housing developments continues at a fast pace in this area (personal observation). The loss of small forested wetlands, like this vernal pool, will continue as long as there are no incentives to preserve these important amphibian breeding habitats. Destruction of amphibian habitat in this area is representative of a trend that has been accelerating for over a century. Bragg (1960) observed the loss of breeding habitats around Norman, Oklahoma due to the expansion of urban and suburban development following World War II. Minton (1968) and Klemens (1993) reported similar losses in Indiana and New England, respectively.

Documentation of the flora and fauna of an area before it is destroyed for urban, suburban, industrial, or transportation purposes should be made at every opportunity. Such examples, when published, may strengthen the concern about the loss of wetland habitat, support continued efforts to more effectively educate landowners as to the value of these habitats, and provide support for regulatory actions (e.g., Roble, 1989) to protect sensitive and biologically rich environments exemplified by vernal pools.

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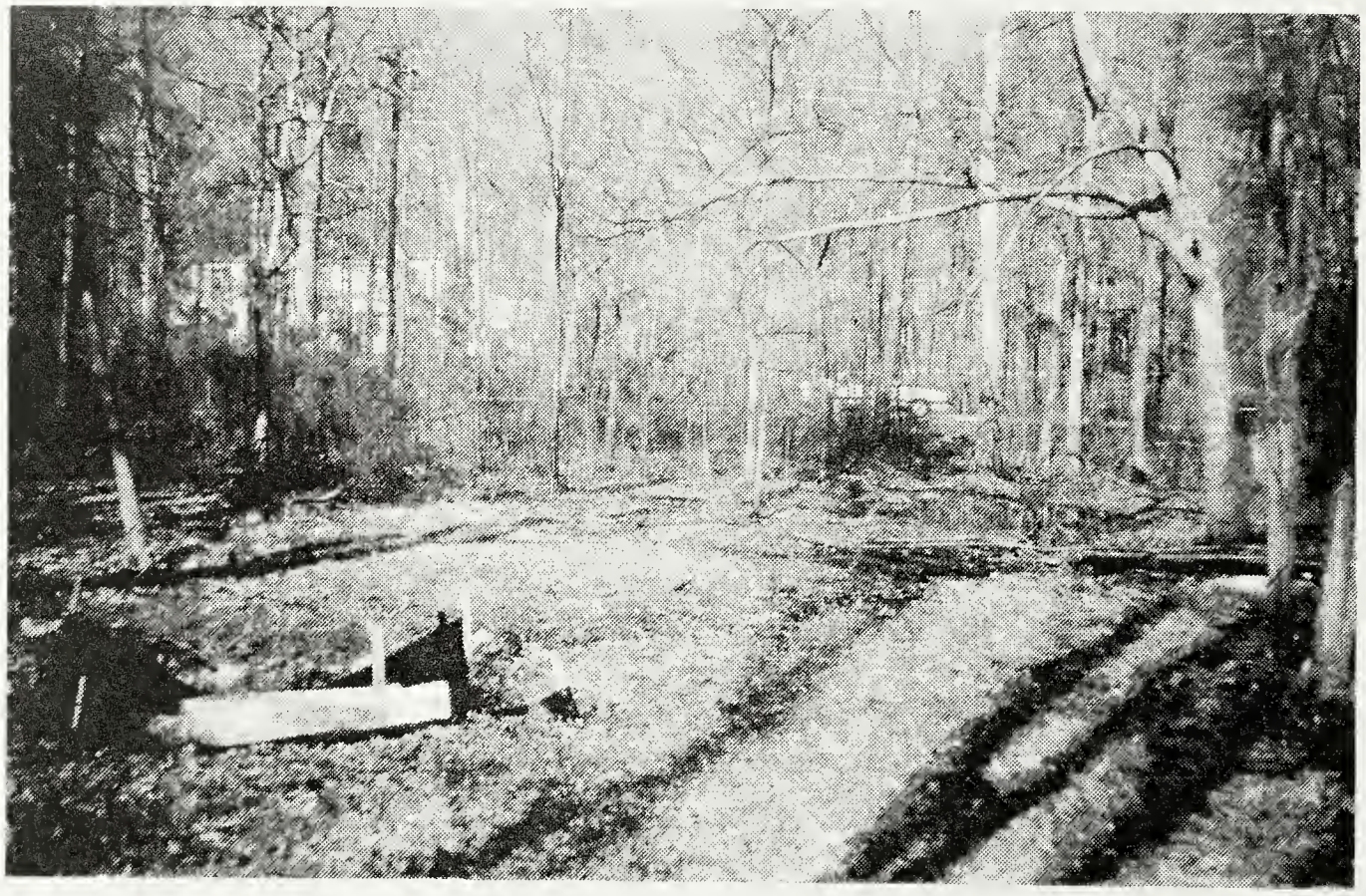

Figure 1. The vestigial woodland vernal pool at Salisbury, Chesterfield County, Virginia on 20 March 1996. Note the concrete drainage system at the margin of the former pool.

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